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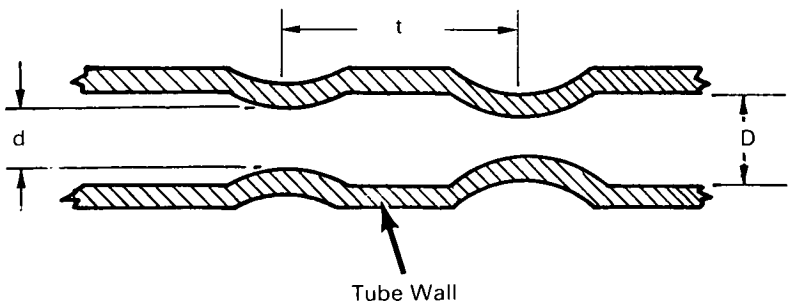
Brief B69-10201

NASA TECH BRIEF

Ultra-High-Flux Heat Exchanger



The problem:

In attempting to substantially increase the heat flux in a concentric-tube heat exchanger, it was found that film binding on the inner wall of the annular flow passage for the high-velocity fluid was the limiting factor in the system. Losses reached as high as 50 percent of theoretical heat flux values in terms of Btu per unit surface area.

The solution:

The wall of the inner tube was interrupted by a regularly spaced pattern of precisely formed depressions, alleviating the film-binding phenomenon without significantly degrading the flow characteristics.

How it's done:

For high-efficiency heat transfer between two fluid streams flowing at very high (near sonic) velocities, the concentric-tube configuration is generally accepted as the preferred design. Fluid flow may be either cocurrent or countercurrent depending on the specific use, but in either case the rate (Btu per unit surface area) limiting factor is found to be the tube wall separating the inner (axial) passage from the outer (annular) passage.

The specific mechanism responsible for this limitation is associated with film binding along this wall. In a given configuration it is found that the application of a regular pattern of spherical "dimples" applied to this wall surface eliminates this problem without significantly affecting other parameters of the system. Dimensions and spacing of these dimples are found to be critical and a satisfactory relationship is found in a t/D ratio of 5.0 and a d/D ratio of 0.88 (see attached sketch).

This design modification prevents film binding with minimum change in exposed area or pressure drop, and prevents severe thermal stratification in the flowing fluids.

Notes:

1. This technique can be successfully applied to any concentric-tube heat exchanger, and is found to be of particular value with systems utilizing very-high-velocity fluid flows. It can contribute substantially to designs that are space-limited or time-limited in continuous-process feed streams, such as those found in the petroleum and petrochemical industries.

(continued overleaf)

2. No further documentation is available. Inquiries may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B69-10201

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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